

Ultrafast pump-probe experiments at APS 7ID

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Shpyrko Group Meeting

11/5/2012

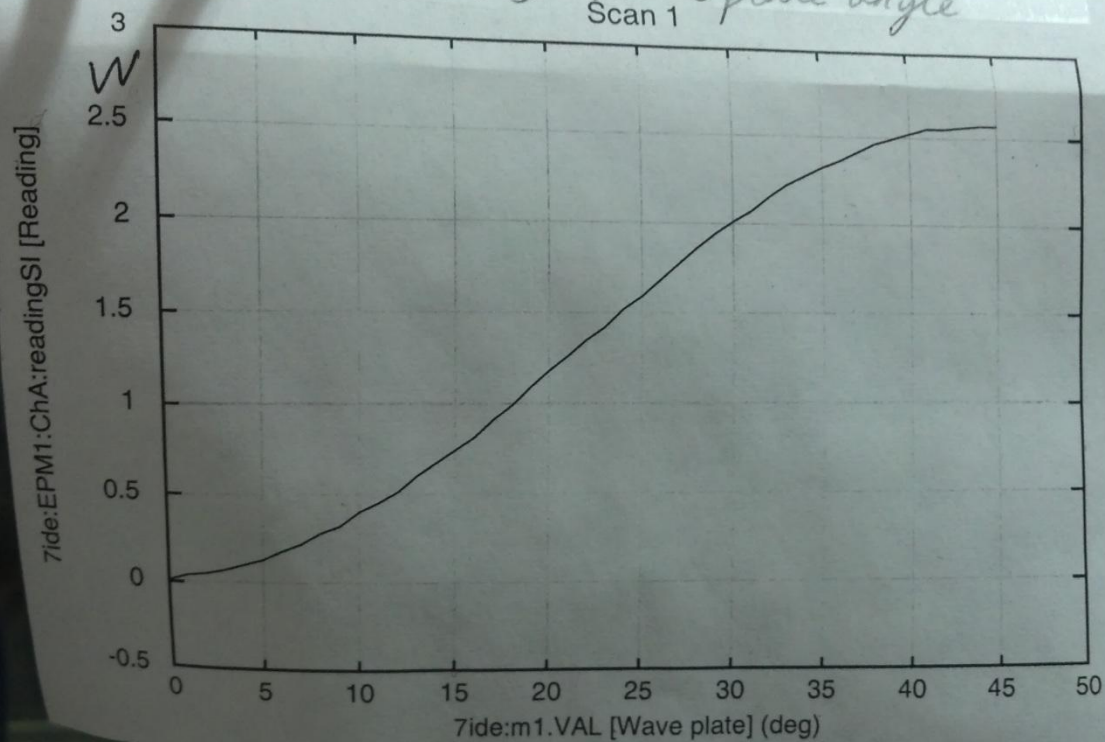
What do I mean by “ultrafast” “pump” “probe” ?

- 100 ps resolution
- IR Laser pump
- Hard X-ray probe

Laser Properties

- Wavelength: 800nm
- Pulse width: 40 fs
- Operates at 1kHz or 5kHz repetition rate
- Power: 2.5 W

Laser Power VS Wave plate angle
Scan 1



beam

X-Ray Properties

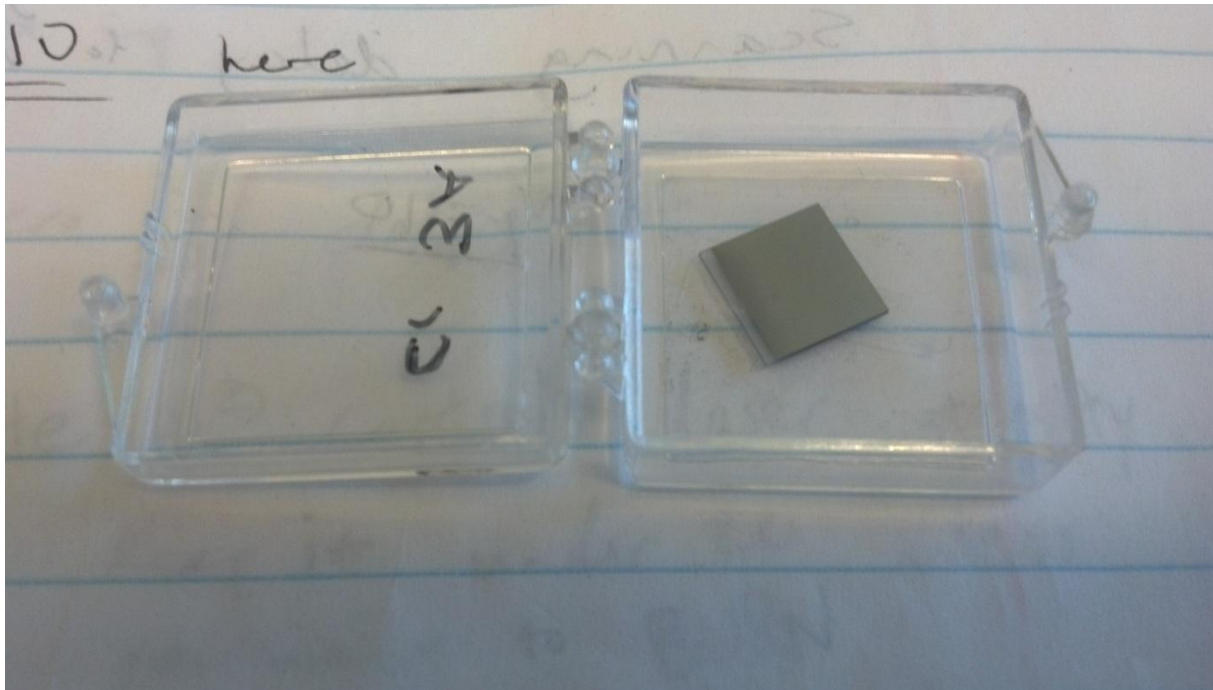
- Energy: 10.5 keV (tunable from 6 to 21 keV)
- Pulse length: 33.5 ps
- Pulse frequency: 6.54 MHz (one pulse every 153 ns)
- Beam spot size: 500 μ m \times 500 μ m (unfocused)
 - 10 μ m \times 10 μ m focused

Synchronizing the pump & probe

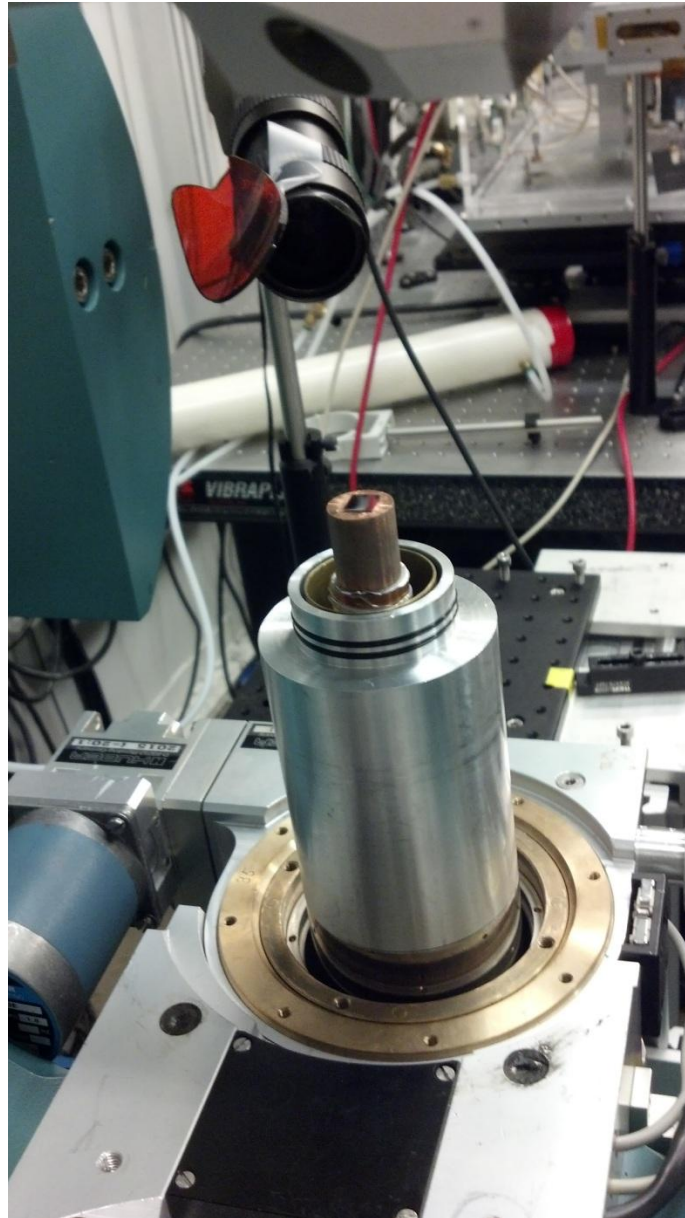
- Laser pulse is triggered by the same RF signal that controls the x-ray bunch frequency
- Mirrors to adjust path length of laser
 - Remember, light travels at ~ 1 foot (~ 300 mm) per nanosecond
- Spinning metal plates (“choppers”) with notches to allow the appropriate x-ray bunch through

Sample: Cr Thin Film

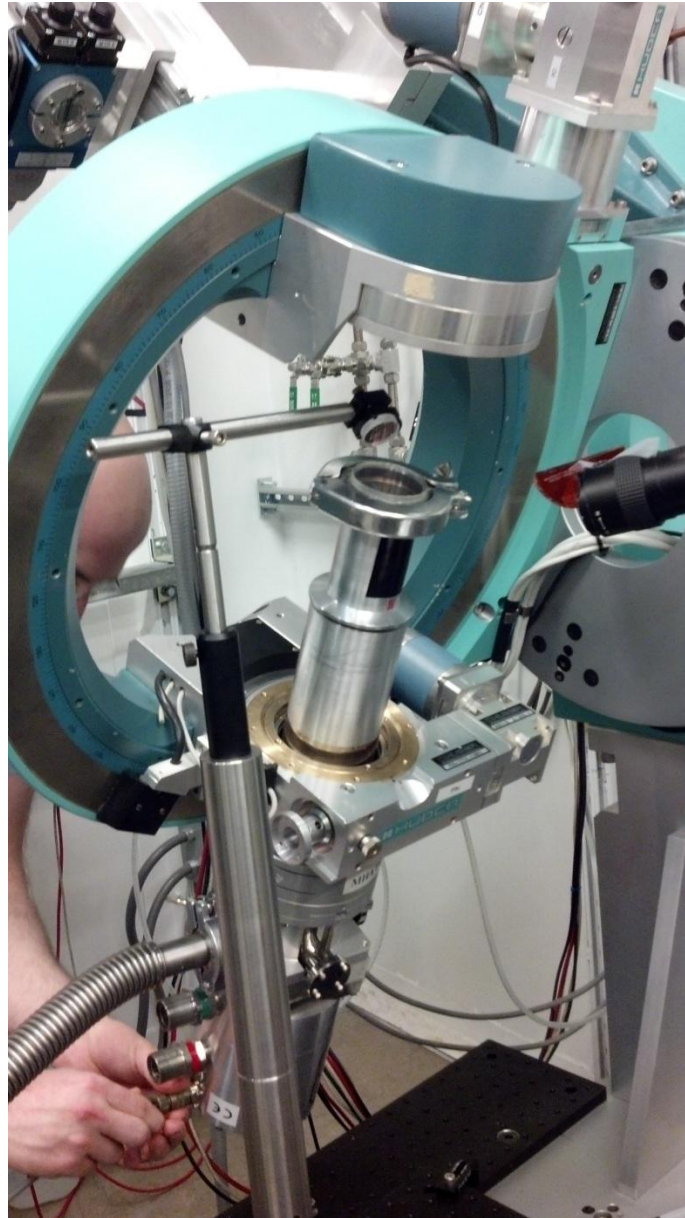
- 20nm Cr on MgO substrate



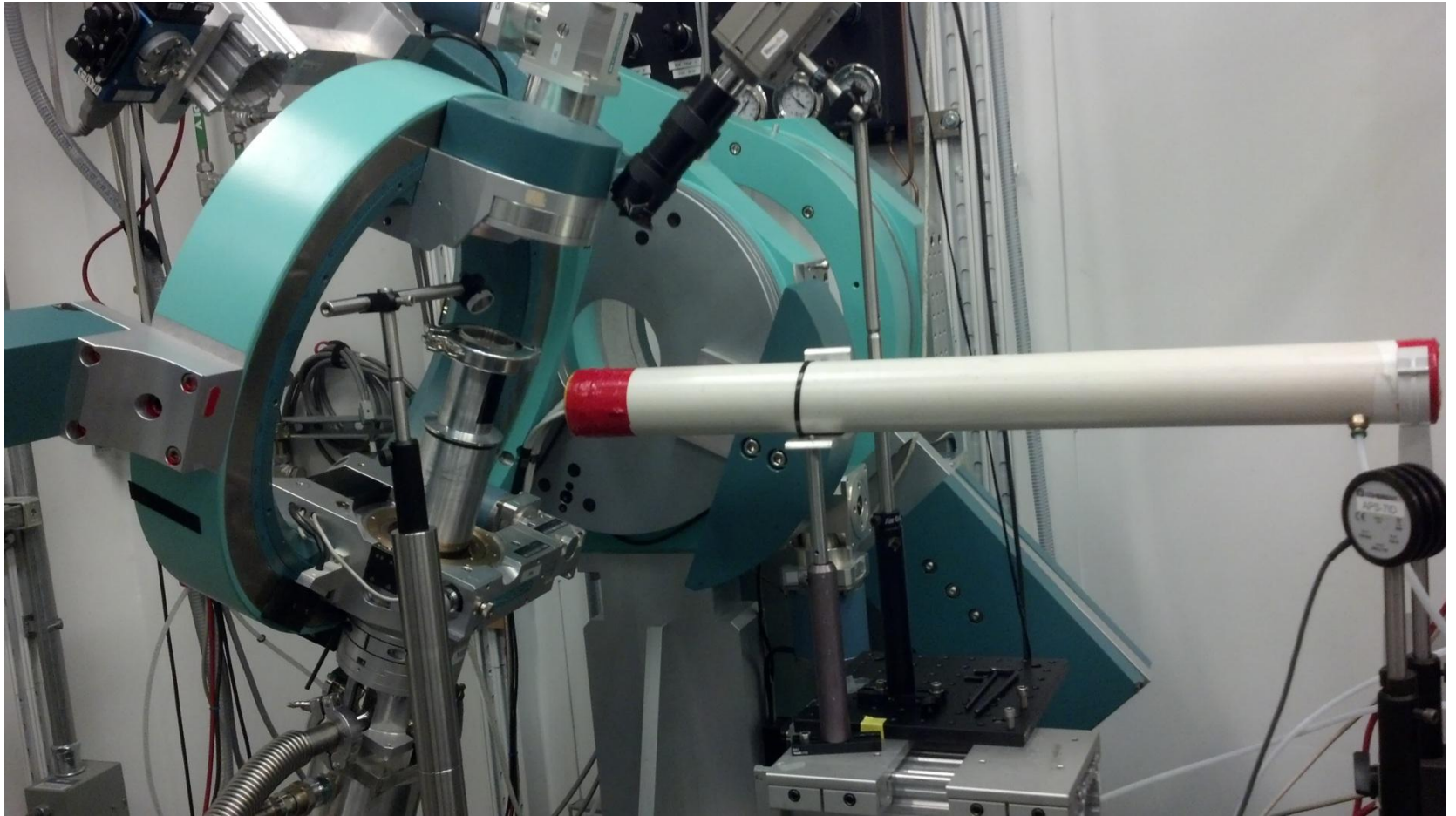
Experimental Setup



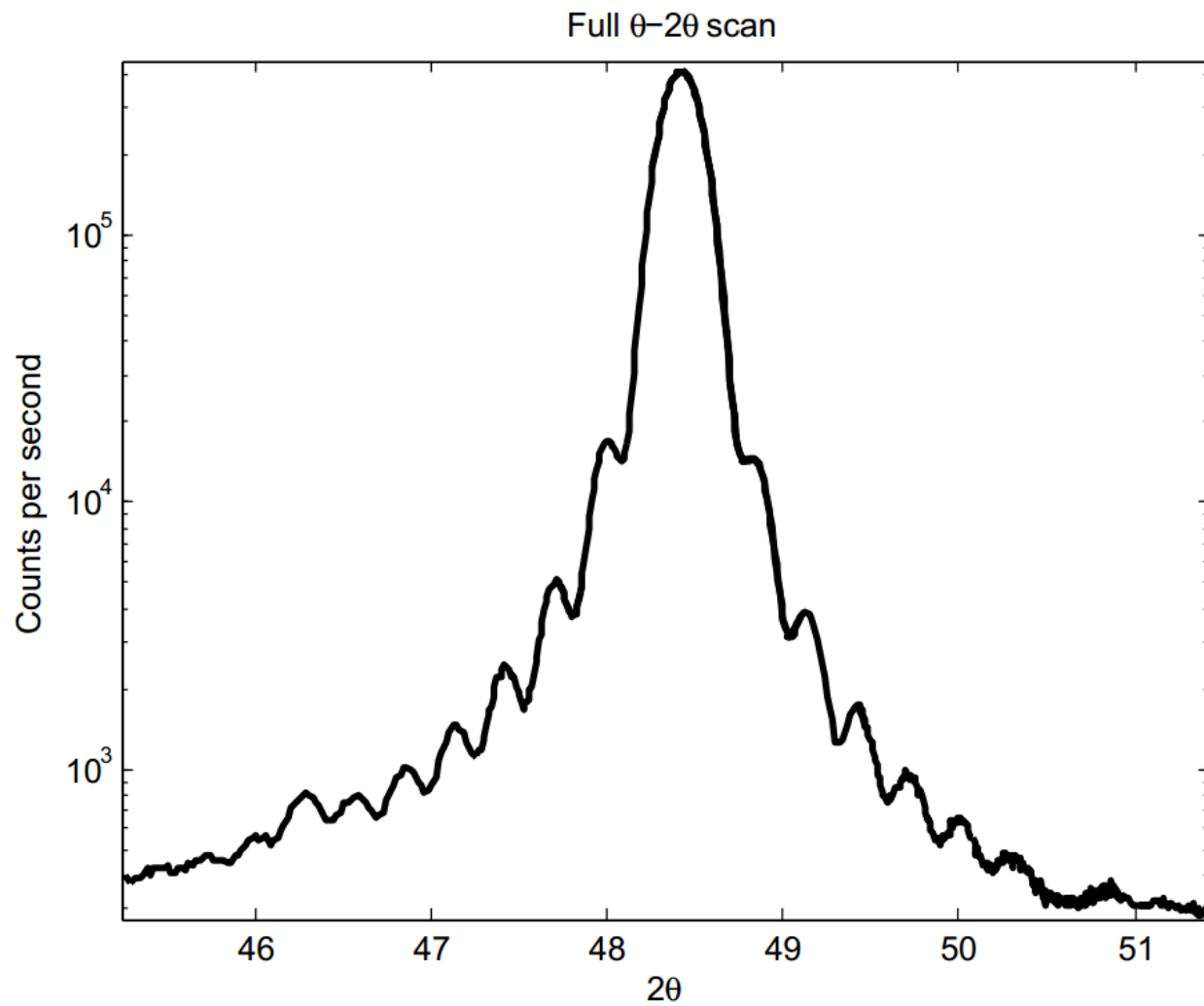
Experimental Setup



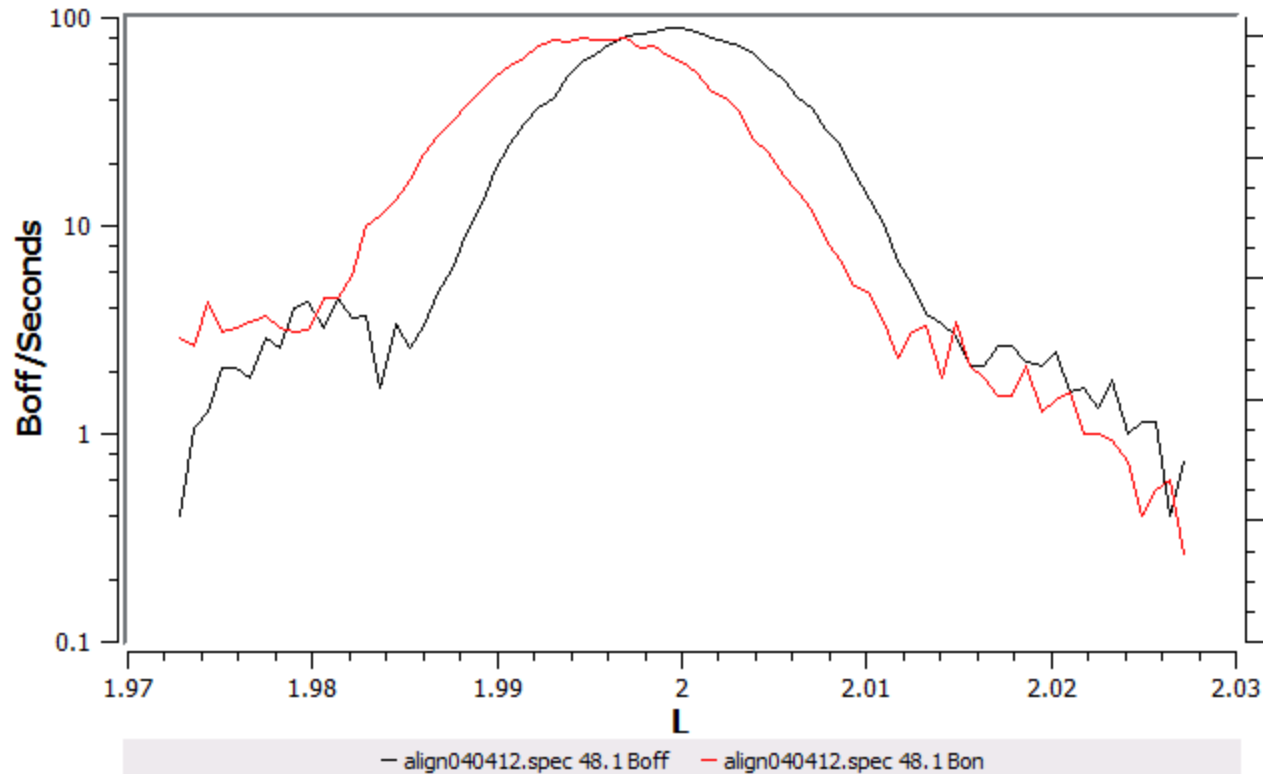
Experimental Setup



Cr (002) peak

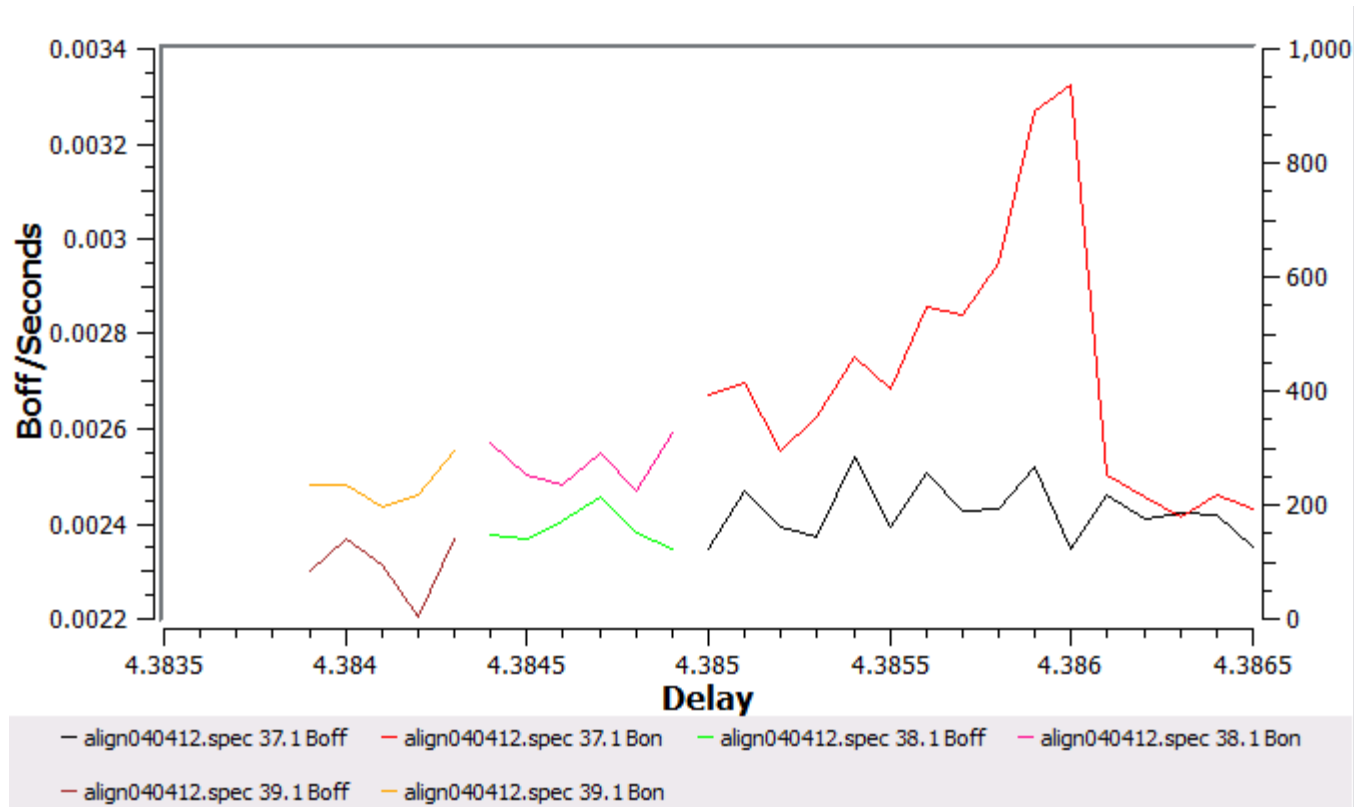


Laser Heating: Bragg Shift



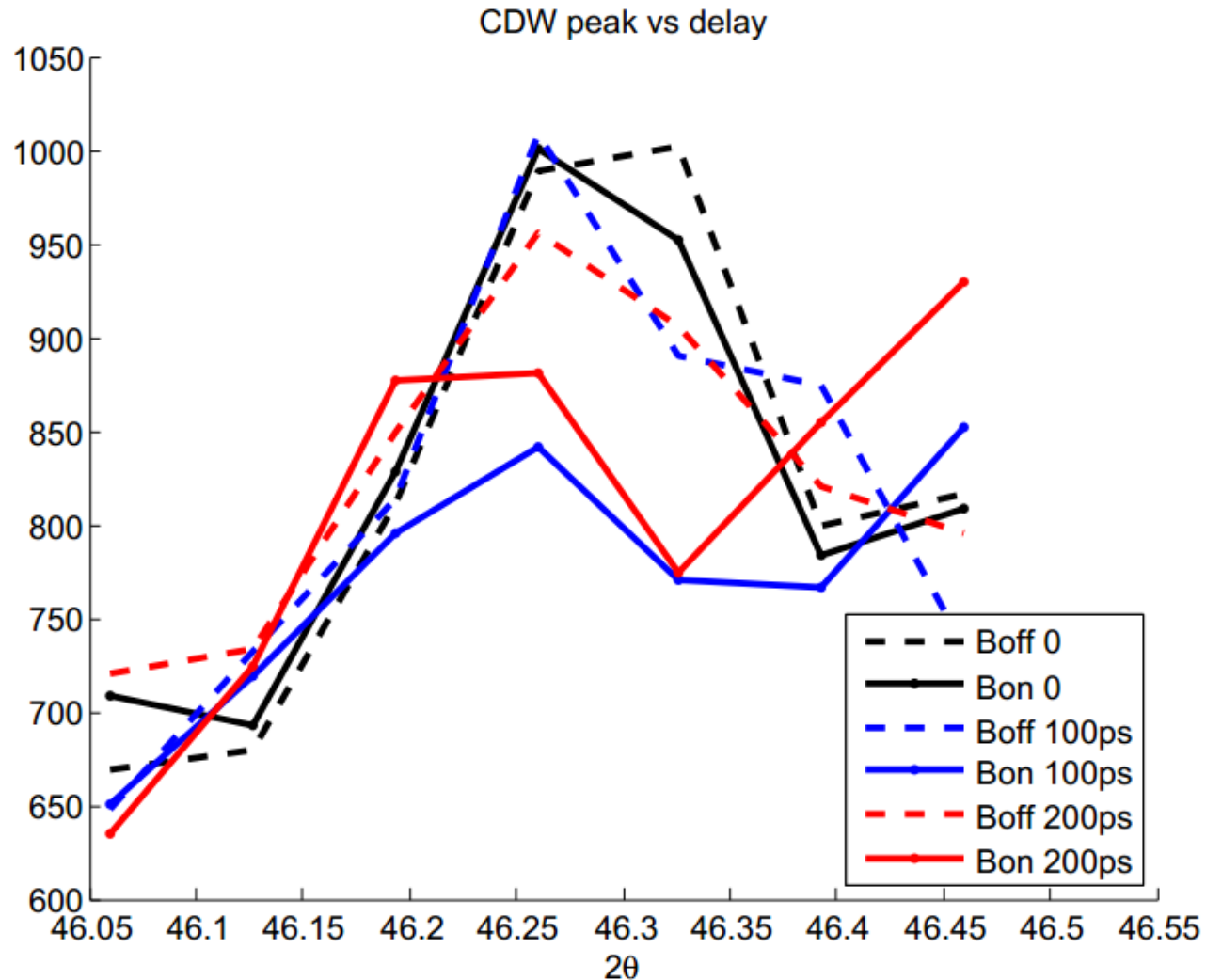
- Black: Laser off, Red: Laser on
- Waveplate @ 20 degrees
- Bragg recovers to original position after 2.4ns

Recovery of Bragg peak

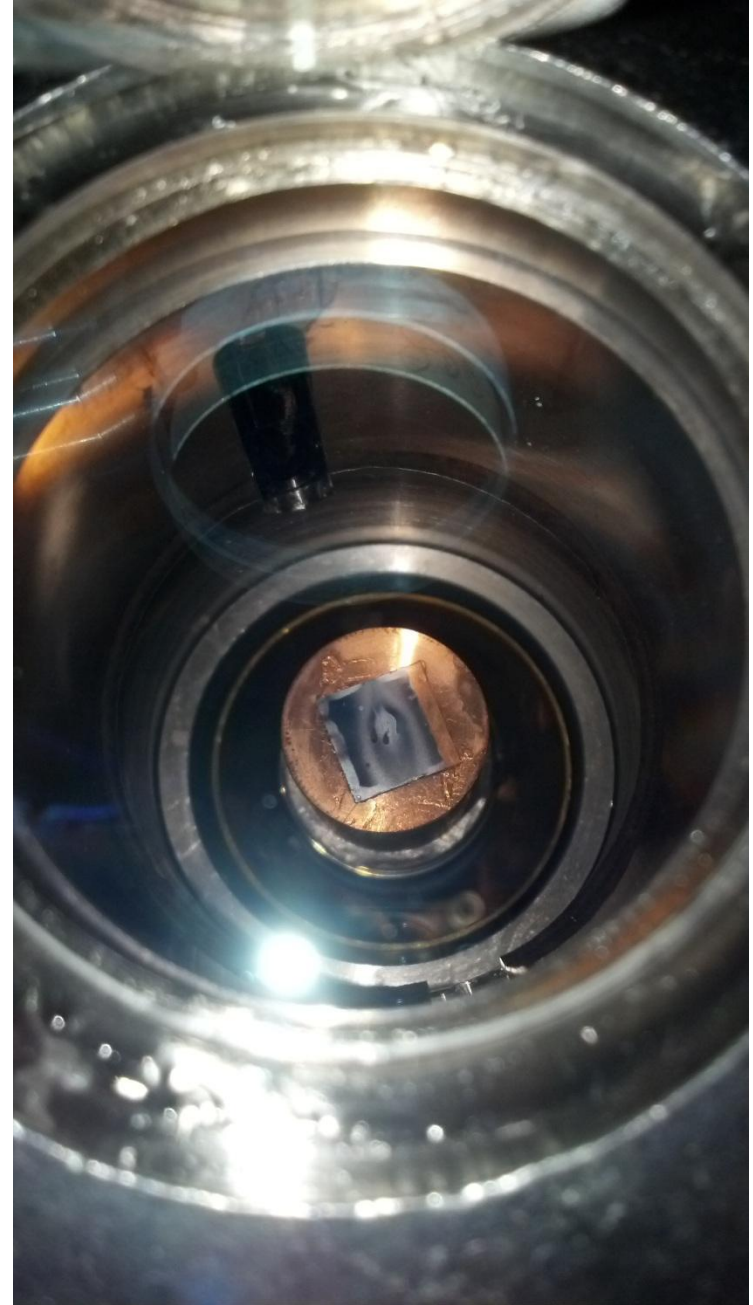
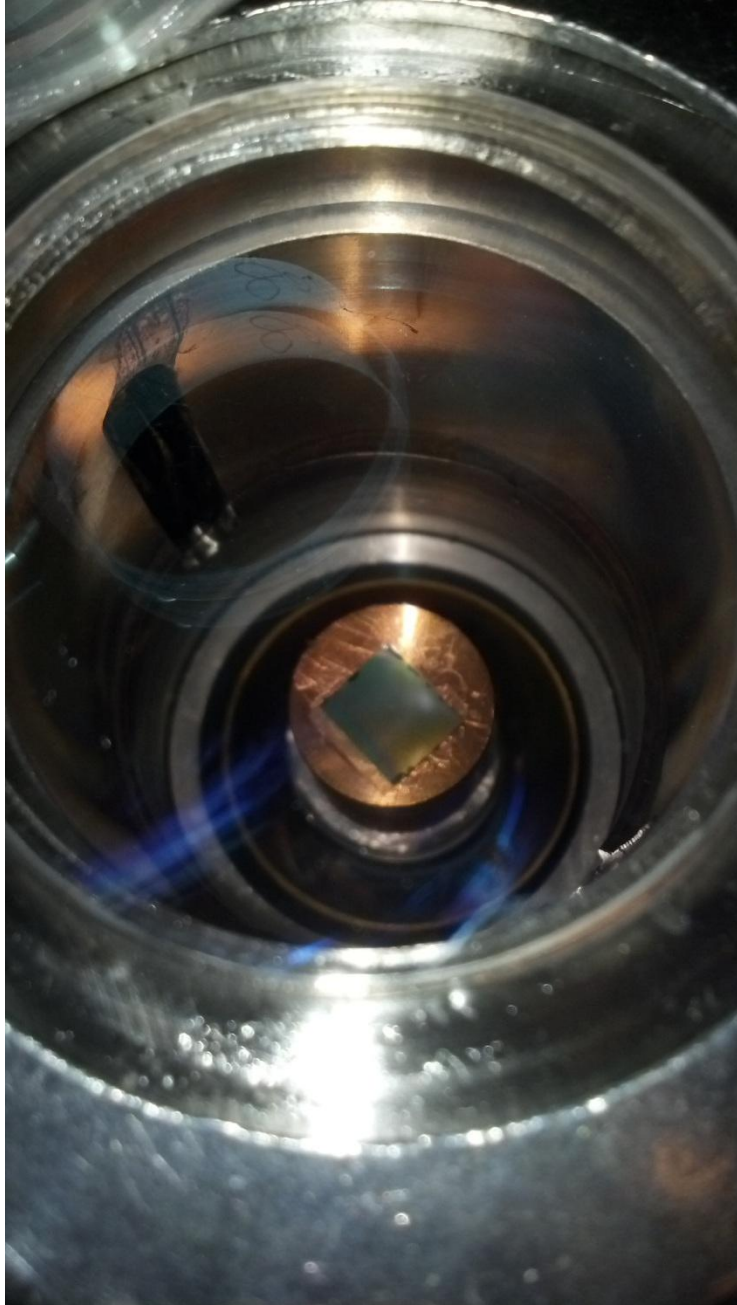


- Fixed angle, sitting just to the left of the peak
- 2.4ns recovery time

CDW Satellite Response



Sample damage



Sample damage

